

# **FIRE PROTECTIVE COAT WITH ENHANCED SLEEVE MOVEMENTS AND REDUCED RISE**

## **BACKGROUND OF THE INVENTION**

### **FIELD OF THE INVENTION**

**[0001]** The present invention relates to fire protective apparel, and more particularly to fire protective coats worn by firefighters, emergency responders and rescue workers.

### **THE PRIOR ART**

**[0002]** Fire protective coats worn by firefighters, emergency responders and rescue workers conventionally include an outer shell made of a fire protective material and a removable liner formed of an outer layer of a moisture barrier material and an inner layer of a thermal material. The removable liner is attachable inside the outer shell so that the moisture barrier layer is located between the thermal layer and the outer shell. In order to facilitate movements of the arms of the person wearing the coat, it is known to provide a central rear pleat in the back panel of the body portion of the outer shell which extends downwardly from the neckline and to provide front and rear pleats in its sleeves near where the sleeves connect to the body portion. The central rear pleat in the back panel enables lateral expansion of the back panel when the sleeves of the outer shell are moved forwardly due to forward movement of the wearer's arms, and the pleats in the sleeves facilitate upward extension of the sleeves of the outer shell when the wearer raises his or her arms.

**[0003]** It is also known to provide similar front and rear pleats in the sleeve portions of the thermal layer of the removable liner to enable these sleeves to extend upwardly with the sleeves of the outer shell.

**[0004]** However, when an SCBA apparatus is positioned on the coat, the shoulder straps thereof will inhibit the functioning of the central rear pleat in the back panel of the outer shell and thus inhibit forward extension of the wearer's arm. And because the moisture barrier layer of the removable liner is not constructed with pleats due to the necessity of maintaining a waterproof seal, this layer tends to inhibit full sleeve movement of the outer shell in both a forward and upward direction. As a result, the coat will rise or uplift a large amount when the wearer extends his arms upwardly. This is not desirable as a minimum two inch overlap by the bottom of a fire protective coat with cooperating fire protective trousers must be maintained at all times according to code requirements.

**[0005]** A need exists for a fire protective coat having an outer shell and a removable liner which will provide maximum sleeve movements even when an SCBA apparatus is mounted thereon and which will exhibit a minimum rise when its sleeves are extended upwardly.

#### SUMMARY OF THE INVENTION

**[0006]** According to a preferred embodiment of our invention, a fire protective coat is provided which includes an outer shell having a body portion that includes right front panel, a left front panel and a back panel, and right and left sleeve portions sewn to the body portion, the

back panel of the body portion including generally vertical pleats near where the respective right and left sleeve portions are sewn to the body portion, and each of the right and left sleeve portions includes front and rear generally vertical pleats extending downwardly from their front and rear longitudinal seams near where the sleeves are sewn to the body portion. The generally vertical pleats in the back panel of the body portion provide supplemental material that can unfold when a wearer of the coat moves one or both of his or her arms (and thus the associated sleeve portions) forwardly, such that the sleeve portions can freely rotate forwardly to the degree the supplemental material allows. This provides enhanced freedom of forward arm movement to the wearer of the coat even when an SCBA apparatus is worn over the coat, i.e., because the pleats will be located outside the shoulder straps of the apparatus. The pleats in the sleeves result in supplemental material in the bottom sides of the sleeve portions near the armpit areas of the wearer which enables the sleeve portions to freely rotate upwardly to the degree the supplemental material allows. This provides enhanced freedom of upward arm movement to the wearer of the coat and reduced rise or uplift to the bottom of the coat when the wearer's arms are extended upwardly.

**[0007]** The fire protective coat also includes a removable liner which is detachably mounted within the outer shell and which is formed of an outer moisture barrier layer and an inner thermal layer. The inner thermal layer preferably includes a body portion defined by a right front portion, a left front portion and a back portion, and right and left sleeve

portions attached to the body portion, the sleeve portions including front and rear pleats near where the sleeve portions connect to the body portion, as well as darts in its back portion near its respective sleeves to provide expansion material therebelow while tucking in the neck. These pleats and darts in the inner thermal layer accommodate forward and upward extension of its sleeve and the sleeves of the outer shell.

**[0008]** The outer moisture barrier preferably includes a body portion formed of a right front portion, a left front portion and a back portion, and right and left sleeve portions which are connected to the body portion. The sleeve portions of the moisture barrier include front and rear darts near where the sleeve portions connect to the body portion to provide expansion material therebelow while tucking in the neck, as well as darts in its back portion near its respective sleeves to provide expansion material therebelow while tucking in the neck. These darts accommodate forward and upward extension of its sleeves and the sleeves of the outer shell.

**[0009]** A fire protective coat is thus provided which displays enhanced sleeve movements and reduced rise.

**[0010]** The invention will be better understood by reference to the attached drawings, taken in conjunction with the following discussion.

#### **BRIEF DESCRIPTION OF THE DRAWINGS**

**[0011]** Fig. 1 shows a rear view of a person wearing a fire protective coat according to a preferred embodiment of the present

invention, as well as an SCBA apparatus over the coat, the person's arms being in a lowered state,

**[0012]** Figs. 2 and 3 show respective back and front views of the person wearing the inventive fire protective coat and SCBA apparatus of Fig. 1 but wherein the person's arms are extended upwardly,

**[0013]** Fig. 4 is a right rear perspective view of the person wearing the inventive fire protective coat and SCBA apparatus, the person's right arm extending forwardly,

**[0014]** Fig. 5 is a perspective front view of the fire protective coat of Fig. 1 when opened to display the removable liner within its outer shell,

**[0015]** Fig. 5A is a view of a portion of the fire protective coat of Fig. 5 showing the left front panel and the left sleeve of the outer shell, a portion of the left sleeve being broken away to show the moisture barrier layer of the removable liner therewithin,

**[0016]** Fig. 5B is a view similar to Fig. 5A but wherein a portion of both the left sleeve of the outer shell and the corresponding portion of the moisture barrier layer of the removable liner are broken away to show the thermal layer therewithin,

**[0017]** Fig. 6 is a view of another portion of the fire protective coat of Fig. 5 with a portion of the thermal layer of the removable liner broken away to show the moisture barrier layer therebehind,

**[0018]** Fig. 7 is a view of the cuff at the end of the right sleeve of the firefighter's coat of Fig. 1,

**[0019]** Fig. 8 is a cross section of the cuff in Fig. 7 as seen along line 8-8

**[0020]** Fig. 9 is a front view of the moisture barrier of the removable liner when in an opened state, and

**[0021]** Figs. 10-14 depict the steps of providing darts in the moisture barrier of the removable liner.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

**[0022]** A fire protective coat according to the preferred embodiment of this invention is generally identified by reference numeral 10 in Figs. 1-5. It includes an outer shell 20 and a removable liner 60 (see Fig. 5).

**[0023]** As seen in Figs. 1 and 3, the outer shell 20 includes a body portion 21 formed by a right front panel 22, a left front panel 23, a back panel 24, a right sleeve 25, a left sleeve 26, and a collar 27. Storage pockets 22a and 23a are attached to the right and left front panels so as to hang adjacent the bottom edge 15 of the coat.

**[0024]** As can be seen in Figs. 1, 2 and 4, the back panel 24 includes a right vertical pleat 24a that extends downwardly from a shoulder seam 28 at a point near the right sleeve 25 and a left vertical pleat 24b that extends downwardly from the shoulder seam 28 at a point near the left sleeve 26. These pleats, which can be curved as they

extend downwardly from the shoulder seam, provide supplemental material that can unfold when laterally stretched to enable a wearer of the coat to freely move his arms and the sleeves of the outer shell forwardly without resistance from the back panel. These pleats are located near the adjacent sleeves 25 and 26 so as to be outside the shoulder straps 201 and 202 of an SCBA apparatus 200. A typical average distance between the pleats and the sleeves is 1 to 3 inches, preferably about 1½ inches.

**[0025]** As can be seen from Figs. 1-4, the right sleeve 25 includes a front pleat 25a that extends downwardly from the front longitudinal seam 29 of the right sleeve and a rear pleat 25b that extends downwardly from the rear longitudinal seam 30 of the right sleeve. Likewise, the left sleeve 26 includes a front pleat 26a that extends downwardly from the front longitudinal seam 31 of the left sleeve and a rear pleat 26b that extends downwardly from the rear longitudinal seam 32 of the left sleeve. The front and rear pleats in each sleeve are generally in register and function to provide additional sleeve material in the underside of the sleeves which enables the wearer of the coat to raise his arms without initially causing any raise or uplift in the bottom edge 15 of the coat. These pleats can be centered between 1 and 3 inches from the seam connecting the sleeves to the body portion 21, preferably ½ inches.

**[0026]** Figs. 5, 5a, 5b and 6 depict the fire protective coat 10 opened so as to see the removable liner 40 therein, this liner including an outer moisture barrier layer 60 and an inner thermal layer 50. The

removable liner 40 can be attached to face portions on the front edges of the outer shell by spaced snap fasteners and to the collar 27 by cooperating hook and loop fastening strips (not shown) in a conventional manner. The liner (and each of the layers thereof) includes a body portion having right and left front portions, a back portion and right and left sleeve portions attached to the body portion.

**[0027]** The back portion of the body portion 51 of the thermal layer 50 includes a right dart 52 that extends downwardly from a seam 53 which extends downwardly from an upper edge of the back portion to an annular seam 54 that connects the right sleeve 55 thereof to the body portion 51. A corresponding left dart (not shown) extends downwardly from a corresponding seam that extends downwardly from an upper edge of the back portion to an annular seam that connects the left sleeve thereof to the body portion 51. These darts provide extra thermal barrier material therebelow to accommodate upward sleeve of the sleeves.

**[0028]** These darts can be between 5 and 8 inches in length, preferably about 5½ inches. The right sleeve 55 includes front and rear pleats (only rear pleat 56 is shown in Fig. 5) which extends downwardly from front and rear longitudinal seams (only rear longitudinal seam 56a is shown in Fig. 5) to provide additional thermal barrier material therebelow to accommodate upward sleeve movement. The front and rear pleats can be in register. The left sleeve 57 includes front and rear pleats (only rear pleat 58 is shown in Fig. 5B) which extends downwardly from front and rear longitudinal seams (only rear seam 58a is shown in Fig. 5B) to



provide additional material therebelow to accommodate upward movement of the left sleeve. The front and rear pleats can be in register. These pleats can be centered between 1 and 3 inches from the seams connecting the sleeves 55, to the body portion 51, preferably 1½ inches

**[0029]** As best seen in Fig. 9, the moisture barrier layer 60 includes a body portion 61 that includes a right front portion 62, a left front portion 63, a back portion 64, a right sleeve portion 65 and a left sleeve portion 66. A right dart 67 extends downwardly from a seam 68 that extends from an upper location on the back portion 64 to an endless seam 69 that connects the right sleeve portion 65 to the body portion 61. A corresponding left dart 70 extends downwardly from a seam 71 that extends downwardly from an upper location on the back portion 64 to an endless seam 72 that connects the left sleeve portion 66 to the body portion 61. The right and left darts 67 and 70 provide for extra moisture barrier material therebelow to accommodate upward movement of right and left sleeve portions 65 and 66. These darts can be between 5 and 8 inches in length, preferably 6¼ inches.

**[0030]** The right sleeve portion 65 also includes front and rear darts 65a and 65c which extend down from front and rear longitudinal seams 65b and 65d near the endless seam 69 to provide extra moisture barrier material therebelow to accommodate upward movement of the right sleeve 65. These darts 65a and 65b can be in register. The left sleeve 66 also includes front and rear darts 66a and 66c which extend down from front and rear longitudinal seams 66b and 66d near the

endless seam 72 to provide extra moisture barrier material therebelow to accommodate upward movement of the left sleeve 66. These pleats can be between 1 and 3 inches from the seams connecting the sleeves 65, 66 to the body portion 61, preferably 1¼ inches. The combination of the pleats in the outer shell, the darts and pleats in the thermal layer and the darts in the moisture barrier provide the coat 10 with exceptional sleeve movements, both forwardly and upwardly, without causing a large rise in the lower edge 15 of the coat.

**[0031]** Figs. 7 and 8 show the end of the right sleeve of the fire protective coat, the ends of the sleeve portions of the thermal and moisture barrier layers 50 and 60 being sewn together and to a wrister 100 which will fit around the wrist of a wearer of the coat. The moisture barrier layer 60 includes outwardly facing snap bases 101 located around its periphery. An elastic sleeve well 103 of moisture barrier material is sewn at its outer periphery to the end of the right sleeve 25 of the outer shell and at its inner periphery it includes inwardly facing snap buttons 104 that can attach to the snap bases 101 to attach the ends of the sleeve portions of the layers of the liner to the sleeve of the outer shell. The elastic sleeve well includes a flap portion that can allow the ends of the sleeves of the layers to move inwardly relative to the end of the sleeves of the outer shell, thus providing flexibility to movement of the sleeves of the liner relative to the sleeves of the outer shell.

**[0032]** Figs. 10-14 depict the steps followed in providing the darts in the moisture barrier layer and in sealing the darts on the outer side of the layer (the side facing the outer shell) to prevent moisture penetration.

**[0033]** Although various features of the invention have been shown and described in detail, modifications therein can be made and still fall within the scope of the appended claims.